Claims

[1] An information processing system comprising:

a plurality of memory modules each having a memory and a control device and

data transmission paths for connecting the memory modules and transmitting a value from one of the memory modules to other memory modules,

in which each of the memory modules retains a list of values of a first item and/or a list of values of a second item to be unified, the values being ranked in an ascending or descending order without duplication;

the information processing system being characterized in that

the control device of each of the memory modules comprises:

a data sending means for sending the values included in the value list to the other memory modules;

a data receiving means for receiving the values included in the value list from the other memory modules; and

a unifying means for generating a unified value list in view of the values included in the value lists of the first and the second items in all of the other memory modules by referring to the value list of the first item and the value list of the second item in the other memory modules received by the data receiving means.

[2] The information processing system according to claim 1, characterized in that the unifying means comprises:

a first ranking decision means for referring to the value list of the first item in the each of the memory modules, the value list of the second item in the each of the memory modules, and the value lists of the first and the second items in the other memory modules received by the data receiving means to decide a global value ranking relating to the first item in view of the values included in the value lists of the first and the second items in the each of the memory modules and the other memory modules and storing the decided ranking in a first global order storage array for storing the global value ranking at a position corresponding to a value of the each of the memory modules; and

a second ranking decision means for referring to the value list of the first item in the each of the memory modules, the value list of the second item in the each of the memory modules, and the value lists of the first and the second items in the other memory modules received by the data receiving means to decide a global value ranking relating to the second item in view of the values included in the value lists of the first and the second items in the each of the memory modules and the other memory modules and storing the decided ranking in a second global order storage array for storing the global value ranking at the position corresponding to the value of the each of the

memory modules.

[3] The information processing system according to claim 2, characterized in that

the first ranking decision means compares the values of the value list of the second item in the each of the memory modules, the values of the value lists of the first item in the other memory modules, or the values of the value lists of the second item in the other memory modules with the values of the value list of the first item in the each of the memory modules to find if any of the values in the compared value list is equal to the values of the value list of the first item of the each of the memory modules and deletes the identical value;

the value list of the first item from which the identical value is deleted is sent to the other memory modules via the data transmission path or to the second ranking decision means by the data sending means;

the second ranking decision means compares the values of the value list of the first item in the each of the memory modules, the values of the value lists of the first item in the other memory modules, or the values of the value lists of the second item in the other memory modules with the values of the value list of the second item in the each of the memory modules to find if any of the values in the compared value list is equal to the values of the value list of the second item of the memory module and deletes the identical value; and

the value list of the second item from which the identical value is deleted is sent to the other memory modules via the data transmission path or to the first ranking decision means by the data sending means.

[4] The information processing system according to claim 2 or 3, characterized in that

the control device of each of the memory modules comprises:

a first occurrence count array generation means for generating a first occurrence count array storing occurrence counts of the values in the value list of the second item in all the memory modules; and

a second occurrence count array generation means for generating, based on the occurrence counts in the first occurrence count array relating to the value list of the second item in all the memory modules, a second occurrence count array storing occurrence counts of the values of the value list of the first item, the second occurrence count array corresponding to the occurrence counts in the first occurrence count array.

[5] The information processing system according to claim 4, characterized in that

the first occurrence count array generation means generates a local occurrence count array storing the occurrence counts of the value list of the second item in said

each of the memory modules;

the data sending means sends combinations of the occurrence counts in the local occurrence count array and the corresponding values in the second global value number array; and

the first occurrence count array generation means is arranged to refer to the occurrence counts of the local occurrence count array and the values of the second global value number array in the other memory modules received by the data receiving means and to generate the first occurrence count array in view of the occurrence counts in the local occurrence count array in the other memory module.

[6] The information processing system according to claim 4 or 5, characterized in that

the data sending means sends combinations of the occurrence counts in the first occurrence count array and the values in the first global order storage array to the other memory modules; and

the second occurrence count array generation means is arranged to generate a region for a counter array and a cumulative number array having a size identical to the value list and used as the second occurrence count array in the storage,

the second occurrence count array generation means is arranged to refer to the occurrence counts in the first

occurrence count array in the other memory modules received by the data receiving means, and is arranged to increase a value at a corresponding position in the counter array by a certain value when any of the values in the order storage array in the other memory modules is equal to the value in the first global order storage array in said each of the memory modules, said certain value being said any of the values in the order storage array in the other memory modules and also increase a value at a next storage position number in the cumulative number array by said any of the values in the order storage array in the other memory modules, or increase a value in the cumulative number array at a storage position number next to the position corresponding to the value in the order storage array in the other memory modules by the value in the order storage array in the other memory modules when none of the values in the order storage array in the other memory modules is equal to the values in the first global order storage array in said each of the memory modules, and

the second occurrence count array generation means is arranged to generate a final cumulative number array by accumulating the values of the cumulative number array in the order of the storage position numbers.

[7] The information processing system according to claim 4 or 5, characterized in that

the data sending means sends combinations of the

occurrence counts of the first occurrence count array and the values of the first global order storage array to the other memory modules; and

the second occurrence count array generation means is arranged to generate a region for a counter array and a cumulative number array having a size identical to the value list and used as the second occurrence count array in the storage,

the second occurrence count array generation means is arranged to refer to the occurrence counts of the first occurrence count array in the other memory modules received by the data receiving means, and is arranged to increase a value at a corresponding position in the counter array by a certain value when any of the values in the order storage array in the other memory modules is equal to the value in the first global order storage array in said each of the memory modules, said certain value being said any one of values in the order storage array in the other memory modules, and also increase a value at a next storage position number in the cumulative number array by said any of the values in the order storage array in the other memory modules, or increase the value at the corresponding position in the counter array by "1", when none of the values in the order storage array in the other memory modules is equal to the values in the first global order storage array in said each of the memory modules, store an invalid value

as the value, at the position corresponding to the value in the order storage array in the other memory modules, in the cumulative number array, and increase the value of the storage position number next to the corresponding position by the value of the order storage array in the other memory modules, and

the second occurrence count array generation means is arranged to accumulate the values of the cumulative number array in the order of the storage position numbers.

[8] The information processing system according to any one of claims 4 to 7, characterized in that said information processing system further comprises a data readout means for reading out the values in the value list of the first item based on the occurrence counts in the second occurrence count array such that duplication of identical values is allowed.

[9] The information processing system according to claim 6 or 7, characterized in that said information processing system further comprises:

a data readout means for reading out the values in the value list of the first item based on the occurrence counts of the second occurrence count array such that duplication of identical values is allowed, wherein

the data readout means is arranged to generate a second cumulative number array indicating a total number of records having the values of the order storage array not exceeding the

value of the order storage array of said each of the memory modules by referring to the combinations of the values of the order storage array and corresponding values of the count array of the other memory modules and read out the values in the value list of the first item based on the values of the second cumulative number array, the value of the count array corresponding to the storage position of the second cumulative number, and the value of the final cumulative number array corresponding to the storage position such that duplication of identical values is allowed.

[10] An information processing system comprising:

a plurality of memory modules each having a memory and a control device; and

data transmission paths for connecting the memory modules and transmitting a value from one of the memory modules to other memory modules, wherein

each of the memory modules retains a list of values of a plurality of items, the values being ranked in an ascending or descending order without duplication,

the information processing system being characterized in that

the control device of each of the memory modules retains a plurality of value lists of combinations of unification items including a first and/or a second item to be unified and comprises:

a data sending means for sending the values included in the value lists constituting the combinations of the plural unification items to the other memory modules;

a data receiving means for receiving the values included in the value lists constituting the combinations of the plural unification items from the other memory modules; and

a unifying means for referring to the value list of the first item and the value list of the second item constituting the combinations of the unification items for each of the combinations of the unification items in the other memory modules received by the data receiving means to generate a unified value list in view of the values included in the value lists of the first item and the second item constituting the combinations of the unification items of all of the other memory modules.

[11] The information processing system according to claim 10, characterized in that

the control device of each of the memory modules comprises;

a multidimensional list generation means for generating lists of multidimensional values obtained by joining the items belonging to each of the combinations of the unification items, the lists of the multidimensional values being a first multidimensional item value list obtained by joining the combinations of the first items in the combinations of the

unification items and a second multidimensional item value list obtained by joining the combinations of the second items in the unification items; and

a ranking assigning means for assigning a global value ranking to the first multidimensional items in view of the first multidimensional item value list of the other memory modules by referring to the first multidimensional item value list received by the data receiving means and assigning a global value ranking to the second multidimensional items in view of the second multidimensional item value list of the other memory modules by referring to the second multidimensional item value list received by the data receiving means.

[12] The information processing system according to claim 11, characterized in that

the control device of each of the memory modules further comprises:

a first occurrence count array generation means for generating a first occurrence count array storing occurrence counts of the values included in the second multidimensional item value list in all the memory modules; and

a second occurrence count array generation means for generating a second occurrence count array storing occurrence counts of the values included in the first multidimensional item value list corresponding to the occurrence counts in the first occurrence count array based on the occurrence counts

in the first occurrence count array relating to the second multidimensional item value list in all the memory modules.

[13] The information processing system according to claim 12, characterized in that said information processing system further comprises a data readout means for reading out the values from the first multidimensional item value list based on the occurrence counts in the second occurrence count array such that duplication of identical values is allowed.

[14] A method for unifying a value list in an information processing system comprising:

a plurality of memory modules each having a memory and a control device; and

data transmission paths for connecting the memory modules and transmitting a value from one of the memory modules to other memory modules, wherein

each of the memory modules retains a list of values of a first item and/or a list of values of a second item to be unified, the values being ranked in an ascending or descending order without duplication,

characterized in that the method comprises: in the control device of each of the memory modules,

a data sending step for sending the values included in the value lists to the other memory modules;

a data receiving step for receiving the values included in the value lists from the other memory modules; and

a unifying step for referring to the value list of the first item and the value list of the second item in the other memory modules received in the data receiving step and for generating a unified value list in view of the values included in the value lists of the first and the second items of all of the other memory modules.

[15] The method according to claim 14, the unifying step comprises:

a first ranking decision step for referring to the value list of the first item in the each of memory modules, the value list of the second item in the each of the memory modules, as well as the value lists of the first and the second items in the other memory modules received by the data receiving step and for deciding a global value ranking relating to the first item in view of the values included in the value lists of the first item and the second item in the each of the memory modules and in the value lists of the first item and second item in the other memory modules and storing the decided ranking in a first global order storage array for storing the global value ranking at a position corresponding to the value of the each of the memory modules; and

a second ranking decision step for referring to the value list of the first item in each of the memory modules, the value list of the second item in each of the memory modules, and the value lists of the first and the second items in the other memory

modules received in the data receiving step and for deciding a global value ranking for the second item in view of the values included in the value lists of the first item and the second item in the each of the memory modules and in the value list of the first item and second item in the other memory modules and storing the decided ranking in a second global order storage array for storing the global value ranking at a position corresponding to the value of the each of the memory modules.

[16] The method according to claim 15, the first ranking decision step comprising:

comparing the values of the value list of the second item in the each of the memory modules, the values of the value lists of the first item in the other memory modules, or the values of the value lists of the second item in the other memory modules with the values of the value list of the first item in the each of the memory modules and if any of the values in the compared value list is equal to the values of the value list of the first item in the each of the memory modules deleting the identical value; and

sending the value list of the first item from which the identical value is deleted to the other memory modules via the data transmission path or using the value list of the first item from which the identical value is deleted as a object to be processed in the second ranking decision step, and

the second ranking decision step comprises the steps of:

comparing the values of the value list of the first item in the each of the memory modules, the values of the value lists of the first item of the other memory modules, or the values of the value lists of the second item in the other memory modules with the values of the value list of the second item in the each of the memory modules and if any of the values in the compared value list is equal to the values of the value list of the second item in the each of the memory modules, deleting the identical value; and

sending the value list of the second item from which the identical value is deleted to the other memory modules via the data transmission path or using the value list of the second item from which the identical value is deleted as a object to be processed in the first ranking decision step.

[17] The method according to claim 15 or 16, characterized in that, in the control device of each of the memory modules, the method further comprises:

a first occurrence count array generation step for generating a first occurrence count array storing occurrence counts of the values in the value list of the second item in all the other memory modules; and

a second occurrence count array generation step for generating a second occurrence count array storing occurrence counts of the values in the value list of the first item corresponding to the occurrence counts in the first occurrence

count array based on the occurrence counts of the first occurrence count array relating to the value list of the second item in all the other memory modules.

[18] The method according to claim 17, characterized in that

the first occurrence count array generation step comprises a step for generating a local occurrence count array storing the occurrence counts of the value list of the second item in said each of the memory modules,

the data sending step comprises a step for sending combinations of the occurrence counts in the local occurrence count array and the values in the second global value number array corresponding to the local occurrence count array to the other memory modules, and

the first occurrence count array generation step comprises a step for referring to the occurrence counts in the local occurrence count array and the values of the second global value number array in the other memory module received in the data receiving step and for generating the first occurrence count array in view of the occurrence counts in the local occurrence count array in the other memory modules.

[19] The method according to claim 17 or 18, characterized in that

the data sending step comprises a step for sending combinations of the occurrence counts in the first occurrence count array and the values of the first global order storage

array to the other memory modules; and

the second occurrence count array generation step comprises:

a step for generating a region for a counter array and a cumulative number array having a size identical to the value list and used as the second occurrence count array in the storage; and

a step for referring to the occurrence counts in the first occurrence count array from the other memory module received in the data receiving step, for increasing a value at a corresponding position in the counter array by a certain value when any of the values in the order storage array in the other memory modules is equal to the value in the first global order storage array in said each of the memory modules, said certain value being said any of the values in the order storage array in the other memory modules and also increasing a value at a next storage position number in the cumulative number array by said any of the values in the order storage array in the other memory modules, or increasing a value in the cumulative number array at a storage position number next to the position corresponding to the value in the order storage array in the other memory modules by the value in the order storage array in the other memory modules when none of the values in the order storage array in the other memory modules is equal to the values in the first global order storage array in said each of the

memory modules, and for generating a final cumulative number array by accumulating the values of the cumulative number array in the order of the storage position numbers.

[20] The method according to claim 17 or 18, characterized in that

the data sending step comprises a step for sending combinations of the occurrence counts of the first occurrence count array and the first global order storage array to the other memory modules, and

the second occurrence count array generation step comprises:

a step for generating a region for a counter array and a cumulative number array having a size identical to the value list and used as the second occurrence count array in the storage; and

a step for referring to the occurrence counts in the first occurrence count array from the other memory module received in the data receiving step, for increasing a value at a corresponding position in the counter array by a certain value when any of the values in the order storage array in the other memory modules is equal to the value in the first global order storage array in said each of the memory modules, said certain value being said any one of values in the order storage array in the other memory modules, and also increasing a value at a next storage position number in the cumulative number array

by said any of the values in the order storage array in the other memory modules, or increasing the value at the corresponding position in the counter array by "1", when none of the values in the order storage array in the other memory modules is equal to the values in the first global order storage array in said each of the memory modules, storing an invalid value as the value, at the position corresponding to the value in the order storage array in the other memory modules, in the cumulative number array, and increasing the value of the storage position number next to the corresponding position by the value of the order storage array in the other memory modules, and for generating a final cumulative number array by accumulating the values of the cumulative number array in the order of the storage position numbers.

[21] The method according to any one of claims 17 to 20, characterized in that the method further comprises a data readout step for reading out the values in the value list of the first item based on the occurrence counts in the second occurrence count array such that duplication of identical values is allowed.

[22] The method according to claim 19 or 20, characterized in that the method further comprises:

a data readout step for reading out the values in the value list of the first item based on the occurrence counts in the second occurrence count array such that duplication of

identical values is allowed, and in that

the data readout step comprises:

a step for generating a second cumulative number array indicating a total number of records having the values of the order storage array not exceeding the values of the order storage array of said each of the memory modules by referring to the combinations of the values of the order storage array and corresponding values of the count array of the other memory modules; and

a step for reading out the values in the value list of the first item based on the values of the second cumulative number array, the value of the count array corresponding to the storage position of the second cumulative number, and the value of the final cumulative number array corresponding to the storage position such that duplication of identical values is allowed.

[23] A method for unifying value lists in control device of each of memory modules in an information processing system, comprising:

a plurality of memory modules each having a memory and a control device; and

data transmission paths for connecting the memory modules and transmitting a value from one of the memory modules to other memory modules,

wherein each of the memory modules retains a list of

values of a plurality of items, the values being ranked in an ascending or descending order without duplication, wherein

the method comprises:

a list retaining step for retaining value lists of combinations of plural unification items including a first and/or a second item to be unified;

a data sending step for sending values included in the value lists constituting the combinations of the plural unification items to the other memory modules;

a data receiving step for receiving values included in the value lists constituting the combinations of the plural unification items from the other memory modules; and

a unifying step for referring to the value list of the first item and the value list of the second item constituting the combinations of the unification items for each of the combinations of the unification items in the other memory modules received in the data receiving step and generating a unified value list in view of the values included in the value lists of the first and the second items constituting the combinations of the unification items in all of the other memory modules.

[24] The method according to claim 23, characterized in that the method further comprises, in control device of each of the memory modules:

a multidimensional list generation step for generating

multidimensional value lists obtained by joining the items belonging to each of the combinations of the unification items, the lists being a first multidimensional item value list obtained by joining the combinations of the first items in the combinations of the unification items and a second multidimensional item value list obtained by joining the combinations of the second items in the unification items; and

an ranking assigning step for assigning a global value ranking to the first multidimensional items in view of the first multidimensional item value list in the other memory modules by referring to the first multidimensional item value list received in the data receiving step and assigning a global value ranking to the second multidimensional items in view of the second multidimensional item value list in the other memory modules by referring to the second multidimensional item value list received in the data receiving step.

[25] The method according to claim 24, characterized in that in the control device of each of the memory modules the method further comprises:

a first occurrence count array generation step for generating a first occurrence count array storing occurrence counts of the values included in the second multidimensional item value list in all the memory modules; and

a second occurrence count array generation step for generating a second occurrence count array storing occurrence

counts of the values included in the first multidimensional item value list corresponding to the occurrence counts in the first occurrence count array based on the occurrence counts in the first occurrence count array relating to the second multidimensional item value list in all the memory modules.

[26] The method according to claim 25, characterized in that the method further comprises a data readout step for reading out the values from the first multidimensional item value list based on the occurrence counts in the second occurrence count array such that duplication of identical values is allowed.